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Oxygen mass transfer in a stirred tank bioreactor using different impeller configurations for environmental purposes

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Abstract

In this study, a miniature stirred tank bioreactor was designed for treatment of waste gas containing benzene, toluene and xylene. Oxygen mass transfer characteristics for various twin and single-impeller systems were investigated for 6 configurations in a vessel with 10 cm of inner diameter and working volume of 1.77L. Three types of impellers, namely, Rushton turbine, Pitched 4blades and Pitched 2blades impellers with downward pumping have been used. Deionized water was used as a liquid phase. With respect to other independent variables such as agitation speed, aeration rate, type of sparger, number of impellers, the relative performance of these impellers was assessed by comparing the values of (K_La) as a key parameter. Based on the experimental data, empirical correlations as a function of the operational conditions have been proposed, to study the oxygen transfer rates from air bubbles generated in the bioreactor. It was shown that twin Rushton turbine configuration demonstrates superior performance (23% to 77% enhancement in K_La) compared with other impeller compositions and that sparger type has negligible effect on oxygen mass transfer rate. Agitation speeds of 400 to 800 rpm were the most efficient speeds for oxygen mass transfer in the stirred bioreactor.

Keywords: Stirred tank bioreactor, Oxygen mass transfer coefficients, Impellers